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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample and a personnel evaluation form are also included. (AG)

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July 1970

U.S. Training and
Employment Service
Technical Report
S-453

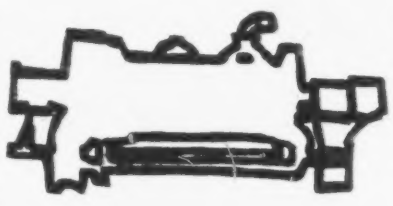
Development of USTES

APTITUDE TEST
BATTERY FOR

SCREW-MACHINE SET-UP OPERATOR, JOBBING

(mach. shop)
604.380

U.S. DEPARTMENT OF LABOR
Manpower Administration



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ED 069640

Technical Report on Development of USTES Aptitude Test Battery

For . . . . .

Screw-Machine Set-Up Operator, Jobbing (mach. shop) 604.380-028

S-453

(Developed in cooperation with the
Wisconsin State Employment Service)

U. S. Department of Labor
Manpower Administration

July 1970

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #2807

Development of USTES Aptitude Test Battery

For

Screw-Machine Set-Up Operator, Jobbing (mach. shop) 604.380-028
S-453

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Screw Machine Set-Up Operator, Jobbing (mach. shop) 604.380-028. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB Scores
N - Numerical Aptitude	80
S - Spatial Aptitude	90
M - Manual Dexterity	75

RESEARCH SUMMARY

Sample:

53 male workers employed as Screw Machine Set-Up Operators in Wisconsin

All are nonminority group members.

Criterion:

Supervisory ratings.

Design:

Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .62 ($P/2 < .0005$)

Effectiveness of Norms:

Only 72 percent of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 90 percent would have been good workers. 28 percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 10 percent would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	72%	90%
Poor Workers	28%	10%

SAMPLE DESCRIPTION

Size:

N = 53

Occupational Status:

Employed workers.

Work Setting:

Workers were employed by Barton Products Corporation, West Bend, Milwaukee Machine Products Company, Mequon and Western Machine Company, Oak Creek, Wisconsin.

Employer Selection Requirements:

Education: High School graduates preferred, but not required.

Previous Experience: Machine operation preferred, but not required.

Tests: None indicated.

Other: Personal interview

Principal Activities:

The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience:

All workers in the final sample had at least 28 months of job experience.

TABLE 2

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, Cultural Exposure and Experience

	Mean	SD	Range	r
Age (years)	38.5	13.5	21-64	-.035
Education (years)	11.2	1.4	6-12	.157
Experience (months)	113.6	103.8	28-363	.273*
Cultural Exposure	3.2	1.5	1-6	.086

*Significant at the .05 level.

Experimental Test Battery

All 12 tests of the GATB, B-1002B, and the Research Questionnaire-Background were administered during February and March 1970.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as the tests were administered with a time interval of three weeks between the two ratings. The immediate supervisor rated each worker.

Rating Scale:

Form SP-21 "Descriptive Rating Scale" was used. The scale (see Appendix) consists of nine items covering different aspects of job performance. Each item has five alternative responses corresponding to different degrees of job proficiency.

Reliability:

A correlation coefficient of .86 was obtained between the initial ratings and the re-ratings indicating satisfactory reliability. The final criterion score consists of the combined scores of the two ratings.

Criterion Score Distribution:

Possible Range:	18-90
Actual Range:	45-77
Mean:	59.2
Standard Deviation:	8.0

Criterion Dichotomy:

The criterion distribution was dichotomized into low and high groups by placing 28 percent of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group are designated as "good workers" and those in the low group as "poor workers." The criterion critical score is 54.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Aptitudes G, N, S and M were considered for inclusion in the norms because they have high correlations with the criterion. Aptitude Q was considered for inclusion in the norms because of its relatively high mean score and its relatively low standard deviation. With employed workers, a relatively high mean score may indicate that some sample preselection has taken place. Tables 3, 4, and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performance.)

Aptitudes	Rationale
G - General Learning Ability	Required in learning the proper machine setup according to specifications on the job layout sheet.
S - Spatial Aptitude	Required in interpreting the specifications of the job from diagrams and instructions on the layout sheet.
P - Form Perception	Required in reading scales, gages, micrometers and calipers for proper settings and dimensions.
F & M - Finger and Manual Dexterity	Required in installing and positioning tools, cams and bar stock and in mounting tool holders using various hand tools in starting and stopping machine.

TABLE 4

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB; N=53

	Mean	SD	Range	r
G - General Learning Ability	102.2	12.7	72-136	.392**
V - Verbal Aptitude	97.3	10.8	72-135	.136
N - Numerical Aptitude	97.6	13.9	69-126	.370**
S - Spatial Aptitude	107.5	16.5	74-150	.486**
P - Form Perception	98.0	15.4	58-133	.088
Q - Clerical Perception	104.6	13.3	69-139	.256
K - Motor Coordination	93.8	14.4	56-124	.171
F - Finger Dexterity	97.3	19.8	44-134	.245
M - Manual Dexterity	100.0	19.5	61-139	.422**

**Significant at the .01 level.

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important	X			X	X			X	X
Irrelevant									
Relatively High Mean	X			X		X			
Relatively Low Standard Dev.	X	X				X			
Significant Correlation with Criterion	X		X	X					X
Aptitudes to be Considered for Trial Norms	G		N	S		Q			M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of the degree to which trial norms consisting of various combinations of Aptitudes G, N, S, Q and M at trial cutting scores were able to differentiate between 72 percent of the sample considered to be good workers and 28 percent of the sample considered to be poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about one-third of the sample; for two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about one-third of the sample. The phi coefficient was used as a basis for comparing trial norms. Norms of N-80, S-90 and M-75 provided optimum differentiation for the occupation of Screw Machine **Set-Up Operator, Jobbing** (mach. shop) 604.380-028. The validity of these norms is shown in Table 6.

TABLE 6

Concurrent Validity of Test Norms
N-80, S-90 and M-75

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	3	35	38
Poor Workers	11	4	15
Total	14	39	53

Phi Coefficient = .62 Chi Square (X^2_y) = 20.4

Significance Level = P/2 < .0005

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP-37 which is shown in the 1970 edition of Section II of the Manual for the General Aptitude Test Battery. A Phi coefficient of .48 is obtained with the OAP-37 norms of N-80, S 95, and M-85.

SP-21

JOB PERFORMANCE RATING FORM
(For Aptitude Test Development Studies)

JOB TITLE _____ SCORE _____
D.O.T. TITLE AND CODE

WORKER'S EXPERIENCE _____ JOB TRAINING PERIOD _____
(Exact number of months) (months)

DIRECTIONS: Please read the sheet "Suggestions to Raters" and then fill in the items listed below. In making your ratings, only one box should be checked for each question.

NAME OF WORKER (print) _____
(last) (first)

SOCIAL SECURITY NUMBER _____ SEX: Male _____ Female _____

COMPANY _____ LOCATION _____

COMPANY JOB TITLE: _____

RATED BY _____ TITLE _____

How often do you see this worker in a work situation?

☐ See him at work all the time.

☐ See him at work several times a day.

☐ See him at work several times a week.

☐ Seldom see him in work situation.

How long have you worked with him?

☐ Under one month.

☐ One to two months.

☐ Three to five months.

☐ Six months or more.

A. How much work can he get done? (Worker's ability to make efficient use of his time and to work at high speed.)

- ☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.
- ☐ 2. Capable of low output. Can perform at a slow pace.
- ☐ 3. Capable of fair work output. Can perform at a acceptable but not a fast pace.
- ☐ 4. Capable of high work output. Can perform at a fast pace.
- ☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of his work? (Worker's ability to do high-grade work which meets quality standards.)

- ☐ 1. Very poor. Does work of unsatisfactory grade. Performance is inferior and almost never meets minimum quality standards.
- ☐ 2. Not too bad, but the grade of his work could stand improvement. Performance is usually acceptable but somewhat inferior in quality.
- ☐ 3. Fair. The grade of his work is mediocre. Performance is acceptable but usually not superior in quality.
- ☐ 4. Good, but the grade of his work is not outstanding. Performance is usually superior in quality.
- ☐ 5. Very good. Does work of outstanding grade. Performance is almost always of the highest quality.

C. How accurate is he in his work? (Worker's ability to avoid making mistakes.)

- ☐ 1. Very inaccurate. Makes very many mistakes. Work needs constant checking.
- ☐ 2. Inaccurate. Makes frequent mistakes. Work needs more checking than is desirable.
- ☐ 3. Fairly accurate. Makes mistakes occasionally. Work needs only normal checking.
- ☐ 4. Accurate. Makes few mistakes. Work seldom needs checking.
- ☐ 5. Highly accurate. Rarely makes a mistake. Work almost never needs checking.

D. How much does he know about his job? (Worker's understanding of the principles, equipment, materials and methods that have to do directly or indirectly with his work.)

- ☐ 1. Has very limited knowledge. Does not know enough to do his job adequately.
- ☐ 2. Has little knowledge. Knows enough to "get by."
- ☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.
- ☐ 4. Has broad knowledge. Knows enough to do good work.
- ☐ 5. Has complete knowledge. Knows his job thoroughly.

E. How much aptitude or facility does he have for this kind of work? (Worker's adeptness or knack for performing his job easily and well.)

- ☐ 1. Very low aptitude. Has great difficulty doing his job. Not at all suited to this kind of work.
- ☐ 2. Low aptitude. Usually has some difficulty doing his job. Not too well suited to this kind of work.
- ☐ 3. Moderate aptitude. Does his job without too much difficulty. Fairly well suited to this kind of work.
- ☐ 4. High aptitude. Usually does his job without difficulty. Well suited to this kind of work.
- ☐ 5. Very high aptitude. Does his job with great ease. Unusually well suited for this kind of work.

F. How large a variety of job duties can he perform efficiently? (Worker's ability to handle several different operations in his work.)

- ☐ 1. A very limited variety. Cannot perform different operations adequately.
- ☐ 2. A small variety. Can perform few different operations efficiently.
- ☐ 3. A moderate variety. Can perform some different operations with reasonable efficiency.
- ☐ 4. A large variety. Can perform several different operations efficiently.
- ☐ 5. An unusually large variety. Can do very many different operations efficiently.

G. How resourceful is he when something different comes up or something out of the ordinary occurs? (Worker's ability to apply what he already knows to a new situation.)

- ☐ 1. Very unresourceful. Almost never is able to figure out what to do. Needs help on even minor problems.
- ☐ 2. Unresourceful. Often has difficulty handling new situations. Needs help on all but simple problems.
- ☐ 3. Fairly resourceful. Sometimes knows what to do, sometimes doesn't. Can deal with problems that are not too complex.
- ☐ 4. Resourceful. Usually able to handle new situations. Needs help on only complex problems.
- ☐ 5. Very resourceful. Practically always figures out what to do himself. Rarely needs help, even on complex problems.

H. How often does he make practical suggestions for doing things in better ways? (Worker's ability to improve work methods.)

- ☐ 1. Never. Sticks strictly with the routine. Contributes nothing in the way of practical suggestions.
- ☐ 2. Very seldom. Slow to see new ways to improve methods. Contributes few practical suggestions.
- ☐ 3. Once in a while. Neither quick nor slow to see new ways to improve methods. Contributes some practical suggestions.
- ☐ 4. Frequently. Quick to see new ways to improve methods. Contributes more than his share of practical suggestions.
- ☐ 5. Very often. Extremely alert to see new ways to improve methods. Contributes an unusually large number of practical suggestions.

I. Considering all the factors already rated, and only these factors, how satisfactory is his work? (Worker's "all-round" ability to do his job.)

- ☐ 1. Definitely unsatisfactory. Would be better off without him. Performance usually not acceptable.
- ☐ 2. Not completely satisfactory. Of limited value to the organization. Performance somewhat inferior.
- ☐ 3. Satisfactory. A fairly proficient worker. Performance generally acceptable.
- ☐ 4. Good. A valuable worker. Performance usually superior.
- ☐ 5. Outstanding. An unusually competent worker. Performance almost always top notch.

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FACT SHEET

Job Title: Screw Machine Set-Up Operator, Jobbing (mach. shop) 604.380-028

Job Summary:

Sets up and operates two or more single or multiple spindle automatic screw machines to perform a sequence of machining operations on metal bar stock to produce a wide variety of screw machine products that meet company quality standards.

Work Performed:

Examines job layout, drawings and specifications to determine size and kind of stock, engine and spindle speeds, cycle time, feed rates, depth of cut, the gears, tools and cams and sequence of operation prescribed by the Engineering department. Installs specified collets, bushings and feed fingers in stock-feeding mechanism using wrenches and screw drivers. Installs and adjusts specified cams and spindle and feed gears and adjusts stops to control stock and tool movement. Selects proper bar stock and inserts into feed tube either manually or with a hoist. Adjusts collet tension or bar stock to prevent stock from slipping. Installs, positions and secures form, shave, recess, facing and cut-off tools, drills, reamers, tape chasers and any other tools required for the correct machining sequence. Moves controls to set cutting speeds and feed rates. Makes trial cut by hand-cranking machine through one cycle and checks dimensions of part to an accuracy of ± .0005 using hand tools, calipers, gages and/or micrometers. Makes any necessary adjustment to tool cutting operations using wrenches, screw drivers and hand tools. When set up is complete and part meets dimensional and finish specifications, part is submitted to inspector for approval. After part passes first-piece-part inspection, starts machine for the production run. Diagnoses machine failure and makes minor repairs to machine and equipment. (Major repairs are made by the Millwright). Sharpens dull cutting tools with a tool grinder and/or bench grinder. May assist in the training of apprentices or trainees in the set up and operation of the machines he sets up and operates.

Effectiveness of S-453 Norms:

Only 72 percent of the nontest-selected workers used for this study were good workers; if the workers had been test-selected with these norms, 90 percent would have been good workers. 28 percent of the nontest-selected workers used for this study were poor workers; if the workers had been test-selected with these norms, only 10 percent would have been poor workers.

Applicability of S-453 Norms:

The aptitude test battery is applicable to jobs which include a majority of the job duties described above.

GPO 901.850